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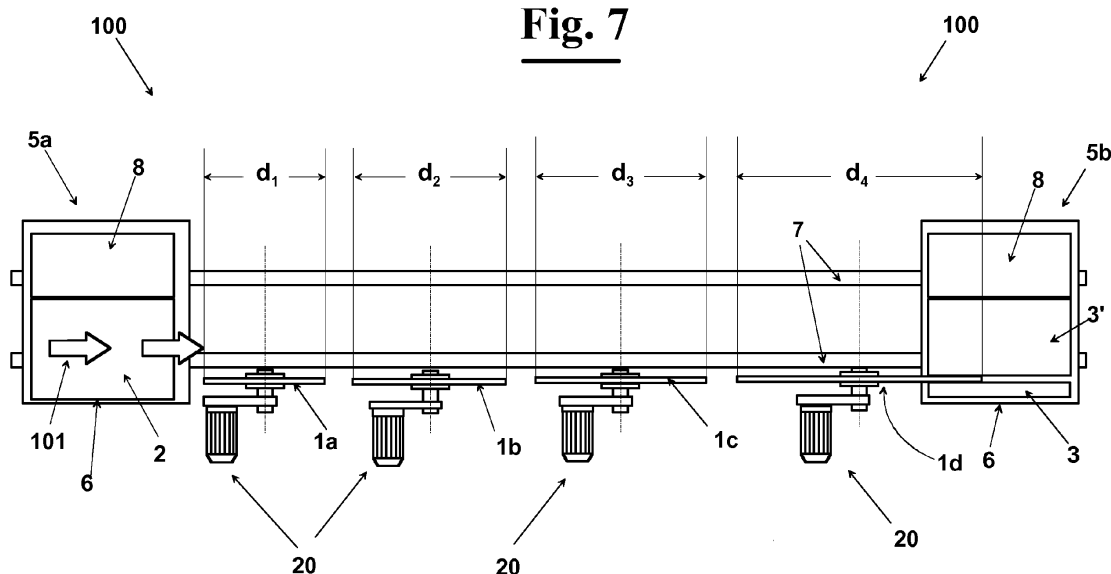
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(54) **Improved structure of a machine for cutting blocks made of a stony material in slabs having a predetermined thickness**

(57) A machine for cutting a block (2) of large size and made of stone, such as marble, granite, and similar material, into slabs (3) of predetermined thickness (s). The machine (100) comprising a block holding carriage (5) on which, in use, at least one block (2) to be treated is arranged and that is slidingly mounted along a conveying direction (101). The machine (100) also comprises a plurality (10a,10b) of cutting discs (1a-1d) arranged at one side of the block (2) made of stone to be worked. More in detail, the series (10a,10b) of cutting discs (1a-1d) comprises a predetermined number of cutting discs

(1a-1d) mounted to respective drive shafts (14) arranged parallel to each other and having a diameter d increasing along the conveying direction (101). At least one cutting disc (1a-1d) of the series (10a, 10b) has a large diameter d that is larger than 1500 mm and a thickness, at a cutting profile (4), set between 1 mm and 10 mm. The disc of large diameter has a shaped hole (11) and a coupling means is provided (12,22,13,23) arranged to block, by a matching shape, the cutting disc (1a-1d) of large diameter d and the drive shaft (14) on which the cutting disc (1a-1d) of large diameter is mounted.

Fig. 7



Description

Field of the invention

[0001] The present invention relates to the field of machines for cutting blocks of stone such as marble, granite, or other similar material and, in particular it relates to an improved structure of machine for cutting blocks of stone into slabs of predetermined thickness.

[0002] The present invention relates also to an improved process for cutting blocks of stone into slabs of predetermined thickness.

Description of the prior art

[0003] As well known, there are machines that provide cutting blocks of stone such as marble, granite, or similar material into slabs of predetermined thickness.

[0004] The machines normally used cut a block into slabs provide a frame on which diamond knives operate that are mounted to a blade holder and reciprocated by means of flywheels and connecting rods.

[0005] However, this kind of machines has a high limitation on the speed and therefore does not allow a high production speed.

[0006] This drawback is partially overcome by another type of machines that carry out the cutting of blocks into slabs by means of one or several diamond wires that operate at high speed.

[0007] However, the latter kind of machines has high problems of safety, since cases are not infrequent where the break of the diamond wires occurs risking the safety of the operators near the machine.

[0008] Another type of machines for cutting blocks of stone into slabs of predetermined thickness is described, for example, in US4131103.

[0009] In this case the machine for cutting the blocks of stone is equipped with a plurality of arrays of diamond discs. Each array of diamond discs is provided with a shaft on which a predetermined number of discs is mounted, arranged at a distance from each other.

[0010] However, this kind of machines can process blocks of small size and precisely of 200 mm width, 300 mm height and about 1200 mm length. This is due to precise technical limits of this kind of machines that can be equipped with discs of small diameter only. The machine described in US4131103 provides only the use of discs of 500 mm diameter.

[0011] In W02007/009436 a process is described for cutting slabs of a predetermined initial thickness into slabs of lower thickness. In this case the machine has a single series of diamond discs of increasing size. Each disc of the series cuts the slab up to a depth substantially corresponding to its radius. In this case, the use is provided of first and second conveyors that engage the slab to be processed at opposite faces and that convey the slab through the series of diamond discs that provide its cutting.

[0012] The prior art machines above described cannot be used for processing blocks having a large size along the direction of cutting. More precisely, the machines in which the diamond discs operate the cut along a substantially horizontal plane cannot have a width larger than 600-700 mm. Analogously, the machines equipped with diamond discs that operate the cutting along a substantially vertical plane are not able to process blocks having a height higher than 600-700 mm.

[0013] In order to be able to process blocks of large size along the cutting direction, in fact, the machines should be equipped with discs of large diameter. More in detail, also in the machine configuration that needs discs of smaller size, i.e. in the configuration that provides a first series of diamond discs arranged at one side of the block and of a second plurality of discs at the opposite side, the diameter of the discs same has to be, in any case, at least equal to the length of the block to be cut. Therefore, also in this configuration, in case of blocks having a length along the cutting direction of about 150 cm, it is necessary that the larger discs of each series have diameters of about 150 cm.

[0014] However, the type of coupling that is used between the disc and the shaft in the traditional machines would not allow a precise cut of the block having such a large size along the cutting direction.

[0015] In fact, the use of discs of high diameter, i.e. larger than 600-700 mm, would unavoidably cause a vibration, or oscillation, of the disc during the cutting of the block, i.e. a sliding of the disc on the shaft. Such a limit is due to the type of coupling used for making the disc and the shaft integral with respect to the rotation and that provides a simple pressure coupling between the shaft and the disc.

[0016] This type of coupling between the shaft and the disc would not be able to oppose to the high stresses to which the cutting disc of large diameter would be subject, during the working of the block made of stone. The vibration of the disc during the cutting would cause to obtain not precise surfaces and thus to produce slabs of non-uniform thickness and therefore a final product of low quality. Furthermore, the oscillation of the discs during the cut would cause a production of a high amount of scraps and therefore a decrease in the speed of production of the whole process.

[0017] Another drawback of the oscillation of the disc during the cut is to cause a high wear of the cutting tool that, therefore, need to be replaced frequently.

Summary of the invention

[0018] It is then a feature of the present invention to provide an improved structure of machine for cutting blocks of stone into slabs of predetermined thickness for processing blocks having large size along the cutting direction.

[0019] It is also a feature of the present invention to provide such an improved structure of machine for cutting

blocks of stone into slabs that allows to obtain slabs of small thickness reducing in the meantime the number of working scraps produced during the cut.

[0020] It is a further feature of the present invention to provide such an improved structure of machine for cutting blocks of stone into slabs of predetermined thickness that allows to speed-up the production process without jeopardizing the safety of the operators near the machine.

[0021] These and other features are obtained with the improved structure of machine, according to the invention, for cutting a block made of stone, such as marble, granite, and similar material, into slabs of predetermined thickness, said block having a large size along a cutting direction, said machine comprising:

- a block holding carriage upon which, in use, at least one block made of stone to be processed is arranged, said block holding carriage being slidably mounted along a predetermined conveying direction;
- a series of cutting discs arranged at one side of said block made of stone, said series of cutting discs comprising a predetermined number of cutting discs mounted to respective drive shafts that are arranged parallel one to another, said cutting discs having a diameter d increasing along said conveying direction;

whose main feature is that at least one cutting disc of said series has a large diameter that is larger than 1500 mm and a thickness at a cutting profile arranged to cut said block set between 1 mm and 10 mm, said disc of large diameter having a shaped hole, and wherein a coupling means is arranged to block by a matching shape said cutting disc of large diameter and said drive shaft on which said cutting disc of large diameter is mounted.

[0022] The particular structural solution used by the present invention allows a high productive speed also in case of blocks having large size, by providing cutting discs of large diameter, without jeopardizing in any case the safety of the operators near the machine.

[0023] In particular, the coupling means can comprise:

- a plurality of recesses and protrusions alternate one to another and made at the shaped hole of coupling; and
- a plurality of recesses and protrusions alternate one to another and made at a shaped surface integral to said drive shaft.

[0024] In particular, the shaped hole of the disc can comprise at least three recesses, for example, arranged at an angle of 120° , or four recesses, for example, at an angle of 90° . The shaped surface can provide a protrusion at each recess of the shaped hole and a recess at each protrusion of the shaped hole. In this case the matching shape is obtained between each protrusion of

the shaped hole and each recess of the shaped surface and between each recess of the shaped hole and each protrusion of the shaped surface.

[0025] Advantageously, each cutting disc of said series has a thickness at the cutting profile set between 2 mm and 10 mm, advantageously between 3 mm and 8 mm, preferably between 4 mm and 7 mm, for example about 6 mm.

[0026] In particular, the cutting disc can be made in two parts that, in use, are assembled to each other, and comprising a main portion and an end portion connected to said main portion and made of a diamond material, at the end portion a cutting profile being provided.

[0027] Advantageously, the protrusions of a splined hole are arranged to engage, in use, in the recesses of a splined surface which is integral to the drive shaft, and the recesses of the splined hole are adapted to engage, in use, with the protrusions of the splined surface.

[0028] In a first exemplary embodiment of the invention, the splined surface is the outer surface of the drive shaft. Therefore, in this case a matching shape is obtained directly between the cutting disc and the drive shaft.

[0029] In a possible exemplary embodiment of the invention, a bush is provided that, in use, is mounted to said drive shaft. Therefore, in this case, the coupling means provides a splined surface of the shaped hole of the disc and a shaped surface of the bush.

[0030] In particular, the bush can be fitted on the drive shaft using at least one key. More precisely, the key is adapted to be housed, in use, in a seat defined between the outer surface of the drive shaft and the inner surface of the bush.

[0031] In a further exemplary embodiment, the coupling means comprises:

- a plurality of seats, each seat of said plurality defined by a recess of the shaped hole and a respective recess of the shaped surface integral to the shaft;
- a plurality of keys, each key of said plurality adapted to be housed, in use, in a respective seat of said plurality.

[0032] The shaped surface can be, for example, the outer surface of the bush, or the outer surface of the drive shaft.

[0033] In particular, the plurality of keys comprises at least three keys, for example arranged at a constant angular distance from each other along the surface of the shaped hole.

[0034] In a possible exemplary embodiment of the invention, all the cutting discs of said series have a respective shaped hole, each cutting disc being coupled to the respective drive shaft by means of respective coupling means adapted to block by a matching shape said cutting disc and said drive shaft on which said cutting disc is mounted.

[0035] Advantageously, it is further provided:

- a first series of cutting discs arranged at a first side of a block made of stone to be processed, said first series of cutting discs comprising a predetermined number of cutting discs mounted to respective drive shafts arranged parallel to each other, said cutting discs having a diameter d increasing along the conveying direction of the block;
- a second series of cutting discs comprising a same number of cutting discs of said first series, each disc of said second series mounted to a respective drive shaft and being arranged at the opposite side of a respective disc of said first series with respect to said block made of stone, each cutting disc of said second series having a diameter d increasing in the conveying direction of the block.

[0036] Advantageously, to each drive shaft a plurality of cutting discs is mounted, said cutting discs of said plurality being arranged substantially parallel and having a same diameter.

[0037] Advantageously, a holding disc unit is provided that is mounted, in use, to a respective drive shaft, said holding disc unit comprising:

- at least a first and at least a second cutting disc;
- at least one spacing element that, in use, is arranged in a "sandwich" configuration between said first and said second cutting disc, said spacing element having a width corresponding to the thickness of the slab of stone to be produced;
- a first and a second locking device arranged to laterally block said plurality of discs at opposite sides with respect to said spacing elements.

[0038] Advantageously, each locking device comprises a locking ring nut between which said plurality of cutting discs is fastened, each ring nut arranged to provide a threaded coupling with a corresponding threaded portion of said drive shaft.

[0039] In particular, the block holding carriage can be arranged to convey the block between a starting cutting position and an end cutting position at which the block is divided into at least two portions. Near the end cutting position, but before the end of the cut same, the divided parts, i.e. each slab of stone that is formed and the residual part of the initial block, can be held by at least one support and/or a stabilizer, for example a vertical stabilizer, in particular arranged at the base of the divided part.

[0040] Advantageously, discharge carriage is slidably mounted to rails substantially parallel to the rails on which said block holding carriage is slidably mounted.

[0041] In particular, once ended the cutting, the divided part of the block, i.e. the, or each, slab obtained with the cutting of the block, can be loaded on a discharge carriage that provides to move the, or each, slab away from the working area.

[0042] Furthermore, the discharge carriage is equipped with a tilting device arranged to tilt the slabs

loaded on the discharge carriage for move them away from the working area.

[0043] Advantageously, once the cutting step, or the splitting step, of the block is ended, the block holding carriage is moved back from an end cutting position to a start cutting position at which a block made of stone is arranged on the block holding carriage for being subject to a cutting, or splitting, step into slabs of desired thickness.

[0044] In an exemplary embodiment, the block holding carriage is also slidably arranged along an auxiliary direction substantially orthogonal to the conveying direction of the block to be cut.

[0045] In particular, the block holding carriage is arranged to slide along the auxiliary direction for being approached/removed to/from said rails.

[0046] This way, the block holding carriage can be arranged at a distance, from the centre of the cutting discs, that corresponds to the length H of the block made of stone to be cut. For example, if the discs are arranged with the rotation axis substantially horizontal, the block holding carriage is arranged to slide, in use, along a horizontal plane that is orthogonal to the rotation axis of the cutting discs. Furthermore, the block holding carriage is slidably arranged also along a direction that is substantially vertical in such a way to adapt, as described above, to the length of the block to be cut along the cutting direction. This allows processing blocks of different size.

[0047] The present invention provides that the cutting discs of the machine can be arranged both on substantially horizontal planes and on substantially vertical planes.

Brief description of the drawings

[0048] The invention will be hereafter shown with the following description of an exemplary embodiment thereof, exemplifying but not limitative, with reference to the attached drawings wherein:

- Fig. 1 diagrammatically shows a top plan view of a first exemplary embodiment of an improved structure of machine, according to the invention, for cutting a block made of stone, such as marble, granite, or similar material, into slabs;
- Fig. 2 shows in detail an elevational front view of a first exemplary embodiment of the present invention of a cutting disc;
- Figs. 3 and 4 show perspective views of two possible alternative embodiments provided for the shaped surface that achieves a matching shape with the shaped hole of the cutting disc;
- Figs. 5 and 6 show front elevational views of two possible exemplary embodiments for the cutting disc of Fig. 2;
- Fig. 7 diagrammatically shows a top plan view of some components provided in the cutting machine according to the invention;

- Fig. 8 diagrammatically shows a top plan view of a possible exemplary embodiment of the machine of Fig. 7 of the invention;
- Fig. 9A diagrammatically shows a top plan view of a further exemplary embodiment of the machine of Fig. 7;
- Fig. 9B diagrammatically shows an elevational side view of a particular exemplary embodiment of the block holding carriage;
- Fig. 10 diagrammatically shows an elevational side view of the machine of Fig. 9A;
- Fig. 11 diagrammatically shows an elevational side view of a possible exemplary embodiment of the machine of Fig. 1;
- Figs. 13A to 13D and 14 show front elevational views of two further possible exemplary embodiment for the cutting disc of Fig. 2;
- Figs. 15 and 16 show a cross sectional view of a possible technical solution of the invention to provide cutting unit on each drive shaft.

Detailed description of some exemplary embodiments

[0049] As diagrammatically shown in Fig. 1 and in Figs. from 7 to 10, a machine 100, according to the invention, for cutting blocks 2 made of stone, such as marble, granite and similar material, into slabs 3, comprises a block holding carriage 5 upon which, in use, the block 2 to be processed is arranged. The block holding carriage 5 is slidably mounted along a conveying direction 101. For example, the block holding carriage can be mounted to guides, or rails, 7. The block holding carriage 5 can be, furthermore, associated with a ballast 8 arranged to counterbalance the masses at stake, and, in particular the mass of block 2, and ensuring a correct sliding, along the conveying direction 101, of the carriage 5 and of the block 2 mounted to it.

[0050] As diagrammatically shown in Fig. 1, the machine 100 also comprises a series 10 of cutting discs 1, in particular provided with diamond tools at the cutting profile. The diamond cutting discs 1 are arranged at one side of the block 2 made of stone in process. More in detail, the series 10 of cutting discs 1 comprises a predetermined number of discs 1, for example 4 discs 1a-1d, mounted to respective drive shafts 14 arranged parallel to each other. The cutting discs 1a-1d have a diameter d increasing in the conveying direction 101 of the block 2, i.e. $d_4 > d_3 > d_2 > d_1$.

[0051] According to the present invention, at least one cutting disc 1 of the series 10, for example at least disc 1d, has a large diameter d, i.e. larger than 1500 mm. The thickness of the discs at a respective cutting profile can be set between 1 mm and 10 mm. The use of cutting discs 1 of large diameter d allows to overcome a technical limit of the machines of prior art, i.e. to provide the cut of blocks 2 of large diameter. In order to achieve this result, however, it is necessary to provide a kind of coupling between the disc 1d and the drive shaft 14 on which the

disc is mounted capable of withstanding the high stresses to which the cutting disc 1d is subject during the cutting of the blocks 2 made of stone. In fact, the higher the ratio between diameter d and thickness of disc 1d, the higher the probability that during the cutting of the block, due to the high stresses exercised on the disc that can vibrate, or slip, and therefore jeopardize the whole production process. In order to avoid this drawback the present invention provides that at least the disc 1d of large diameter has a shaped hole and that a means for coupling is arranged to provide a matching shape between the shaped hole and the drive shaft.

[0052] For example, the shaped hole is arranged to provide a matching shape with a shaped surface integral to the drive shaft. Such particular structural solution, as described above, allows using discs 1d of large diameter d and therefore to cut blocks 2 having a length H, in the cutting direction, which is about the half of diameter d of the disc.

[0053] The thickness of the cutting profile 4 can also be less than that one above indicated and can be set, for example, between 2 mm and 10 mm, advantageously between 4 mm and 8 mm, preferably between 5 mm and 7 mm, in particular about 6 mm. The use of such small thicknesses reduces remarkably the amount of scraps that are produced during the cutting and therefore increases remarkably the production rate of the process.

[0054] The cutting discs 1a-1d can have, for example, the diameters d indicated below. The disc 1a can have a diameter d1 set between 800 mm and 1000 mm, the disc 1b can have a diameter d2 set between 1200 mm and 1400 mm, the disc 1c can have a diameter d3 set between 1700 mm and 1900 mm and the disc 1d can have a diameter d4 set between 2200 mm and 2600 mm. However, it is not excluded that the discs can have even larger diameters, or that can be in a higher number, up to a diameter of the last disc of the series 10a of about 3500 mm. Each cutting disc 1 can cut the block 2, for example, up to a depth of about 20-25 cm. Therefore, in general, according to the length l of the block 2 along the cutting direction, the series 1a provides a corresponding number of cutting discs 1, each of which has a corresponding diameter. Each drive shaft 14 is supported by a frame arranged on a foundation, or base 4 and is rotated about its axis 114 by means of a motor 20 associated with a reduction gear 25. In an exemplary embodiment the motor 20 can be a hydraulic motor.

[0055] In the exemplary embodiment of Fig. 2, the shaped hole 11 is a splined hole comprising a plurality of recesses 12 and of protrusions 13 alternate one to another.

[0056] The splined hole 11 is adapted, in particular, to provide a matching shape with a splined surface 21 that is integral, in use, to the drive shaft 14 and which is equipped with a plurality of recesses 22 and of protrusions 23 alternate to one another. The coupling means that, in use, carry out the matching shape, therefore in this case consists of the recesses 12 and the protrusions

13 of the shaped surface of the hole 11 of disc 1 and the recesses 22 and the protrusions 23 of the shaped surface 21 that is integral to the drive shaft 14.

[0057] As diagrammatically shown in Figs. 3 and 4, the splined surface 21 can be made at the drive shaft same 14, or at a bush 15 that is mounted to the shaft 14 and that is, for example, connected to the shaft 14 by means of at least one key 27 (Fig. 12). More in detail, in the exemplary embodiment of Fig. 3, the splined surface 21 is the outer surface of the drive shaft 14. Therefore, the coupling means is adapted, in this case, to provide a matching shape directly between the shaped hole 11 of the cutting disc 1 and the splined surface 21 of the drive shaft 14.

[0058] In the exemplary embodiment of Fig. 4, instead, the splined surface 21 is the outer surface of bush 15 fitted on the drive shaft 14. In this case therefore the coupling means provides the matching shape between the cutting disc 1 and the splined surface 21 of the bush 15.

[0059] For example, the shaped hole 11 of the disc 1 comprises at least three recesses 12a, 12b, 12c, for example at an angular distance α of 120° with respect to one another, and at least three protrusions 13a, 13b, 13c each of which arranged between two following recesses (Fig. 5). In the exemplary embodiment of Fig. 6, instead, four recesses 12a, 12b, 12c and 12d, are provided for example at an angular distance α of 90° , and at least four protrusions 13a, 13b, 13c and 13d each of which located between two subsequent recesses. Normally, in any case, the shaped hole 11 has a number of recesses 12 and of protrusions 13 that is higher than 4, for example equal to 8, as in the case of Fig. 12.

[0060] In the exemplary embodiment of Fig. 12, the protrusions 13 of the splined hole 11 are adapted to engage, in use, in the recesses 22 of the splined surface 21 that is integral to the drive shaft 14 and, in the case of Fig. 12, that is made on the outer surface of the bush 15, and the recesses 12 of the splined hole 11 are adapted to engage, in use, with the protrusions 23 of the splined surface 21.

[0061] In the exemplary embodiment of Figs. 13A to 13D, the coupling means comprises a predetermined number of seats 28, for example 4 seats, each of which defined by a recess 12 of the shaped hole 11 and by a recess 22 of the shaped surface 21 and a key 27 housed within the seats 28. Therefore, the matching shape is made between the drive shaft 14 and the shaped hole 11 by keys 27.

[0062] In a possible exemplary embodiment of the invention, all the cutting discs 1 of the series 10 are coupled to the respective drive shaft 14 by a coupling between the shaped hole 11 comprising a plurality of recesses 12 and of protrusions 13 alternate to one another, said splined hole 11 adapted to provide a matching shape with a splined surface 21 equipped with a plurality of protrusions and recesses alternate to one another and integral to said drive shaft.

[0063] The mechanical components of the machine that in operating conditions are in movement are provided with a safety casing in order to ensure the safety of the operators.

[0064] In the exemplary embodiment of Fig. 4, the machine 100 comprises a first series of cutting discs 10a arranged at a first side of block 2 and a second series 10b of cutting discs 1'a-1'd arranged at the opposite side of the first series 10a of cutting discs 1a-1d with respect to the block 2 made of stone. Even the second series 10b of cutting discs 1'a-1'd comprises a predetermined number of discs mounted to respective drive shafts 14 that are arranged parallel one to another. More in detail, the discs 1a-1d of the first series 10a and the discs 1'a-1'd of the second series 10b, for example four discs for each series, have a respective diameter d increasing in the conveying direction 101 of the block. More precisely, diameter d_1 of the first cutting discs 1a, 1'a, which carves the block 2 that moves along the direction 101, is less than diameter d_2 of the following cutting discs 1b, 1'b, and so on up to the last cutting disc of the series 10a and 10b that have a final respective diameter d suitable to cover all the height H of the block 1 that is processed (Fig. 11).

[0065] In an exemplary embodiment shown for example in Fig. 8, on each drive shaft 14 a plurality of cutting discs 1 is mounted, having a same diameter d and arranged substantially parallel to one another. This way, each block 2 that is worked is, at the same time, split into a number of slabs corresponding to the number of cutting discs 1 that are mounted to the same shaft 14. The particular structural solution used by the present invention allows obtaining a high production rate without jeopardizing the safety of the operators near the machine.

[0066] According to another aspect of the invention, that is diagrammatically shown in Figs. 15 and 16, a holding disc unit 40 is provided comprising at least one first cutting disc 1' and at least one second cutting disc 1'' between which a spacing element 16 is located that has a width L corresponding to the thickness s of the slab 3 of stone to be obtained. The holding disc unit 40 also comprises a first locking device 45a and a second locking device 45b adapted to fix at opposite sides the above described discs 1 and 1' with the spacing element 16 arranged between them. Each locking device 45a and 45b can comprise a locking ring element 17 adapted to provide a screw threaded coupling with a corresponding screw threaded portion 14' of the drive shaft 14.

[0067] In the exemplary embodiment shown in the figure, the holding disc unit 40 comprises, instead, a first, a second and a third cutting disc 1, 1' and 1'' and two spacing elements 16, each of which located between two following cutting discs 1-1''. In this case, therefore, the holding disc unit 40 is adapted to split the processed block 2 in at least two slabs of thickness s' corresponding to the width of each spacing element 16.

[0068] Therefore, the thickness s of the slabs 3 obtained at the end of the cutting step can be adjusted using

spacing elements 16 of width L corresponding to the thickness of the desired slabs 3 to obtain.

[0069] As diagrammatically shown for example in Fig. 7, the block holding carriage 5 is adapted to slide between a start cutting position 5a and an end cutting position 5b. The movement of the block holding carriage 5 along the conveying direction 101 can be obtained for example by means of belts, or chains. Near the end cutting position 5b, the slabs formed 3 are held by supports, not shown in the figure, arranged at the base of the cross sectioned part and/or by stabilizers, for example vertical stabilizers, which are also not shown in the figure in order to simplify the illustration.

[0070] Once the cutting is ended, the slabs 3 are loaded on a discharge carriage 9 that provides to remove the slabs 3 from the working area. More precisely, the discharge carriage 9 is mounted to rails 26 for example parallel to the rails 7 on which the block holding carriage 5 slides during the cutting step. The discharge carriage 9 is provided with a tilting device for tilting the slabs 3 and moving them in a storing area that is external from the working area.

[0071] Once the cutting, or splitting, step of the block is ended, the block holding carriage 5 is moved back from the end cutting position 5b to the start cutting position 5a. Here a block 2 made of stone is mounted to the block holding carriage 5 for providing a cutting step.

[0072] In a further exemplary embodiment that is diagrammatically shown in Fig. 9B, the block holding carriage 5 besides being slidably mounted along the conveying direction 101 during the cutting step, is also slidably arranged along an auxiliary direction 102. More in detail, the auxiliary direction 102 is substantially orthogonal to the conveying direction 101. This can be achieved, for example, providing a base portion 5a of the carriage 5 that is slidably mounted to the rails 7 and a support portion 5b on which the block 2 is mounted. More precisely, the base portion 6a and the support portion 6b can be provided movable towards/away from one another in order to adapt to the size of the block 2 to be treated. For example an actuator can be provided, for example of hydraulic type, adapted to approach/move away from each other the support portion 5b from base portion 5a. Alternatively, or in addition, all the cutting discs can be mounted free of sliding on a support. These solutions allow to adapt machine 100 to the different size of the block 2 to be worked and then to make the machine 100 same highly versatile.

[0073] The foregoing description of a specific embodiment will so fully reveal the invention according to the conceptual point of view, so that others, by applying current knowledge, will be able to modify and/or adapt for various applications such an embodiment without further research and without parting from the invention, and it is therefore to be understood that such adaptations and modifications will have to be considered as equivalent to the specific embodiment. The means and the materials to realise the different functions described herein could

have a different nature without, for this reason, departing from the field of the invention. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Claims

1. Improved structure of machine (100) for cutting a block (2) made of stone, such as marble, granite, and similar material, into slabs (3) of predetermined thickness (s), said block (3) having a large size along a cutting direction, said machine (100) comprising:

- a block holding carriage (5) upon which, in use, at least one block (2) made of stone to be processed is arranged, said block holding carriage (5) being slidably mounted along a conveying direction (101);

- a series (10a,10b) of cutting discs (1a-1d) arranged at one side of said block (2) made of stone to be worked, said series (10a,10b) of cutting discs (1a-1d) comprising a predetermined number of cutting discs (1a-1d) mounted to respective drive shafts (14) that are arranged parallel one to another, said cutting discs (1a-1d) having a diameter d increasing along said conveying direction (101);

characterized in that at least one cutting disc (1a-1d) of said series (10a, 10b) has a large diameter d that is larger than 1500 mm and a thickness at a cutting profile (4) set between 1 mm and 10 mm;

and in that said disc of large diameter has a shaped hole (11);

and in that a coupling means is provided (12,22,13,23) arranged to block by a matching shape said cutting disc (1a-1d) of large diameter and said drive shaft (14) on which said cutting disc (1a-1d) of large diameter is mounted.

2. Improved structure of cutting machine (100), according to claim 1, wherein said coupling means comprises:

- a plurality of recesses (12) and protrusions (13) alternate one to another and made at said shaped hole of coupling (11); and

- a plurality of recesses (22) and protrusions (23) alternate one to another and made at a shaped surface (21) integral to said motor shaft (14).

3. Improved structure of cutting machine (100), according to claim 1, wherein, each cutting disc (1a-1d) of said series (10a, 10b) has a thickness at said cutting profile (4) set between 4 mm and 7 mm.

4. Improved structure of cutting machine (100), accord-

ing to claim 2, wherein said shaped surface (21) is the outer surface of said drive shaft (14).

5. Improved structure of cutting machine (100), according to claim 2, wherein a bush (15) is provided that, in use, is mounted to said drive shaft (14), said shaped surface (21) coinciding in this case with an outer surface of said bush (15).
6. Improved structure of cutting machine (100), according to claim 1, wherein said coupling means comprises:
 - a plurality of seats (28), each seat (28) of said plurality defined by a recess (12) of the shaped hole (11) and by a respective recess (22) of said shaped surface (21) that is integral to said drive shaft (14);
 - a plurality of keys (27), each key (27) of said plurality arranged, in use, in a respective seat (28) of said plurality.
7. Improved structure of cutting machine, according to any of the previous claims, wherein all the cutting discs (1a-1d) of said series (10a, 10b) are provided with a respective shaped hole (11), each cutting disc (1a-1d) being coupled to the respective drive shaft (14) by means of respective coupling means (12, 22, 13, 23) arranged to block by a matching shape said cutting disc (1a-1d) and said respective drive shaft (14) on which said cutting disc (1a-1d) is mounted.
8. Improved structure of cutting machine, according to any of the previous claims, wherein it is provided:
 - a first series (10a) of cutting discs (1a-1d) arranged at a first side of said block (2) made of stone to be worked, said first series (10a) of cutting discs (1a-1d) comprising a predetermined number of cutting discs (1a-1d) mounted to respective drive shafts (14) arranged parallel to each other, said cutting discs (1a-1d) having a diameter d increasing along said conveying direction (101);
 - a second series (10b) of cutting discs (1'a-1'd) comprising a same number of cutting discs (1a-1d) of said first series (10a), each disc (1'a-1'd) of said second series (10b) mounted to a respective drive shaft (14) and being arranged at the opposite side of a respective disc (1a-1d) of said first series (10a) with respect to said block (2) made of stone, each cutting disc (1'a-1'd) of said second series (10b) having a diameter d increasing along said conveying direction (101).
9. Improved structure of cutting machine, according to any of the previous claims, wherein, a plurality of cutting discs (1', 1'', 1''') is mounted to each drive shaft

(14), said cutting discs (1', 1'', 1''') of said plurality being arranged substantially parallel and having a same diameter d.

- 5 10. Improved structure of cutting machine, according to any of the previous claims, wherein, a holding disc unit (40) is provided that, in use, is mounted to a respective drive shaft (14), said holding disc unit (40) comprising:
 - at least a first and at least a second cutting disc (1', 1'');
 - at least one spacing element (16) that, in use, is arranged in a "sandwich" configuration between said first and said second cutting disc (1', 1''), said spacing element having a width corresponding to the thickness (s) of the slab (3) made of stone to be produced;
 - a first and a second locking device (45a, 45b) arranged to laterally block said plurality of discs (1', 1'') at opposite sides with respect to said spacing elements (16).
11. Improved structure of cutting machine (100), according to any of the previous claims, wherein, said block holding carriage (5) is adapted to carry said block (2) between a starting cutting position (5a) and an end cutting position (5b) at which said block (2) is divided into at least one slab (3') of predetermined thickness (s) and in a portion (5') of said block (5) and wherein near said end cutting position, but before the end of the cut same, said slab (3) is arranged to be held by means of at least one support and/or by means of a stabilizer.
12. Improved structure of cutting machine, according to any of the previous claims, wherein, at least one discharge carriage (9) is provided on which said, or each, slab (3) is arranged, at the end of the cutting step, said discharge carriage (9) arranged to remove said slab (3) from a working area, said discharge carriage (9) being slidably mounted to rails (26) substantially parallel to the rails (7) on which said block holding carriage (5) is sliding mounted.
13. Improved structure of cutting machine, according to any of the previous claims, wherein, said discharge carriage (9) is equipped with a tilting device arranged to tilt said slabs (3) mounted to said discharge carriage (9) in such a way to move said slabs (3) away from said working area.
14. Improved structure of cutting machine, according to any of the previous claims, wherein, said block holding carriage (5) besides being slidably mounted along said conveying direction (101), during the cutting step is slidably arranged along an auxiliary direction (102) that is substantially orthogonal to said

conveying direction (101), said block holding carriage (5) arranged to slide along said auxiliary direction (102) for being approached/removed to/from said rails (7).

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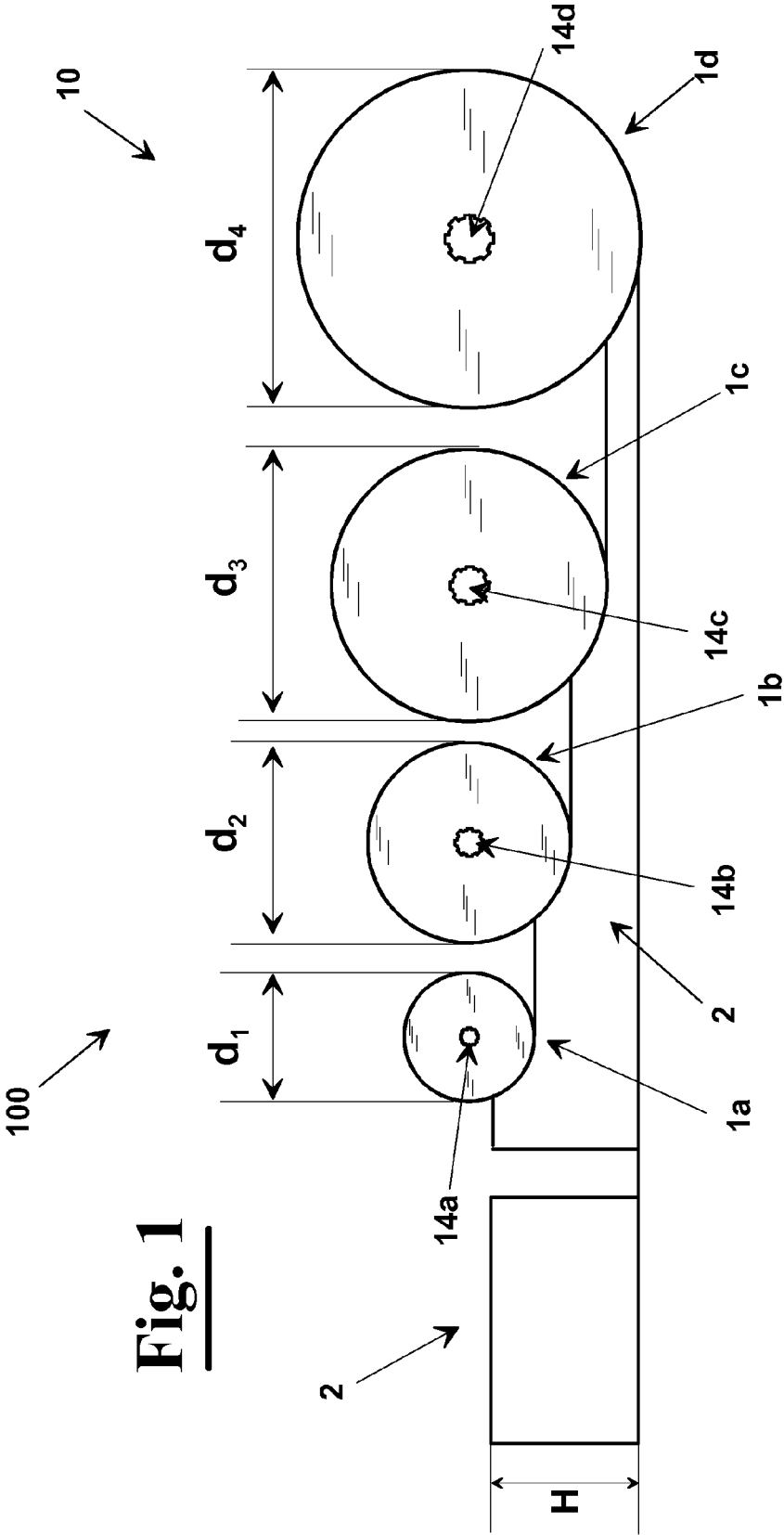


Fig. 2

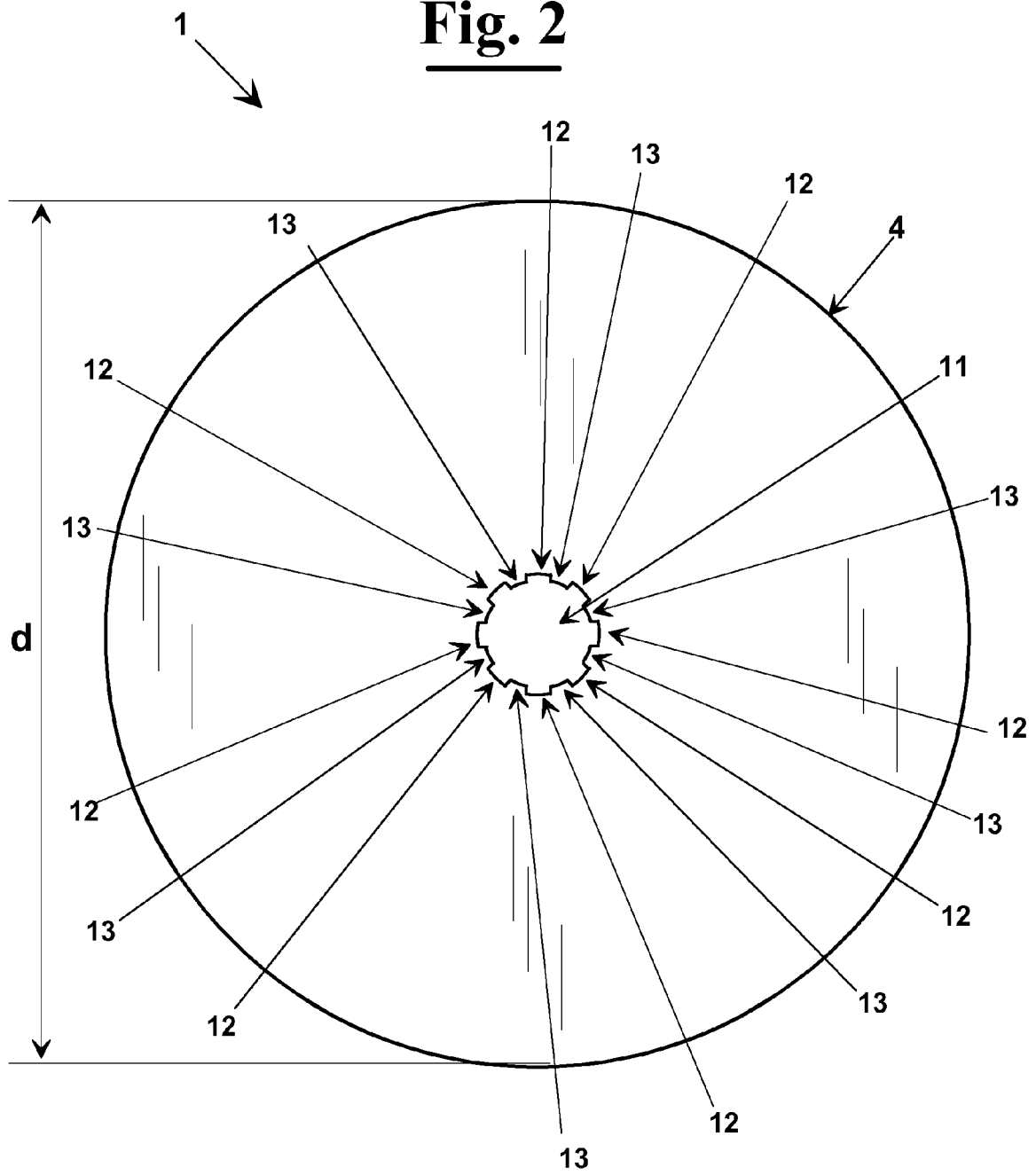


Fig. 3

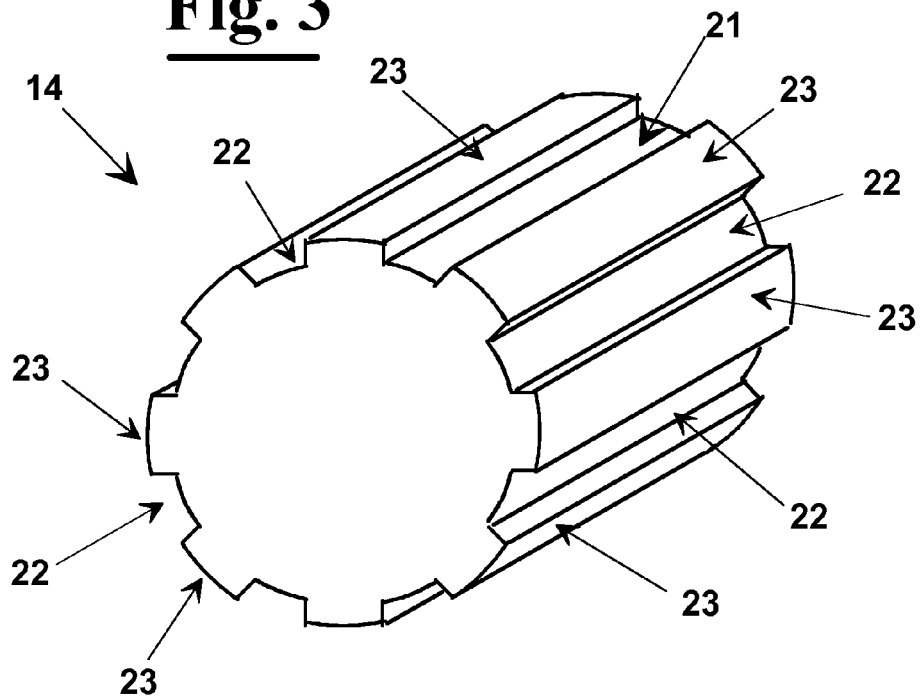


Fig. 4

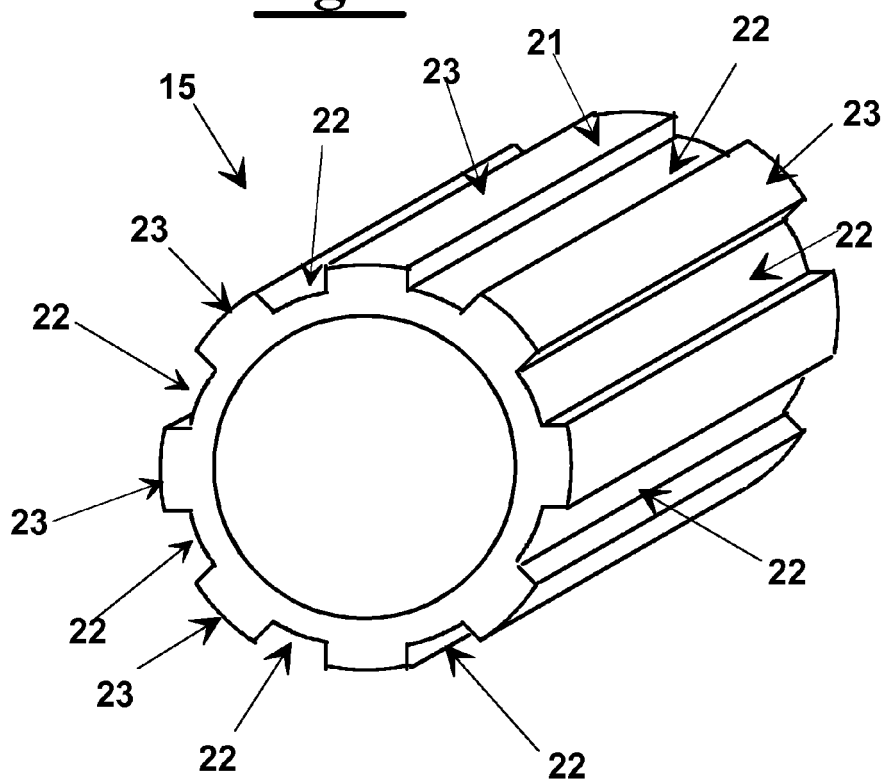


Fig. 5

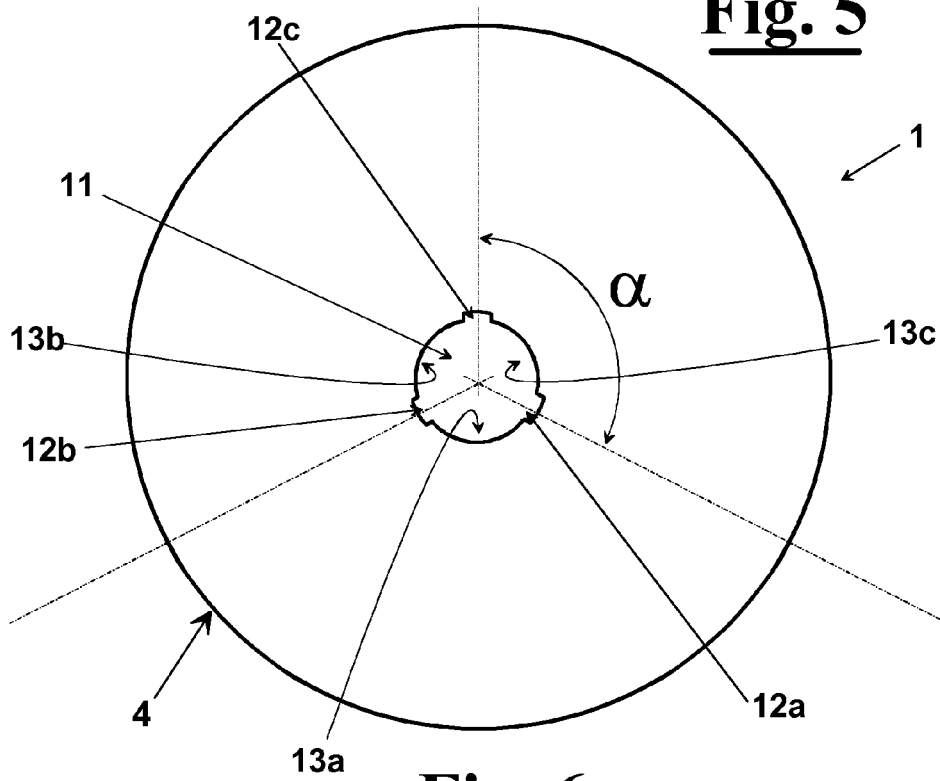


Fig. 6

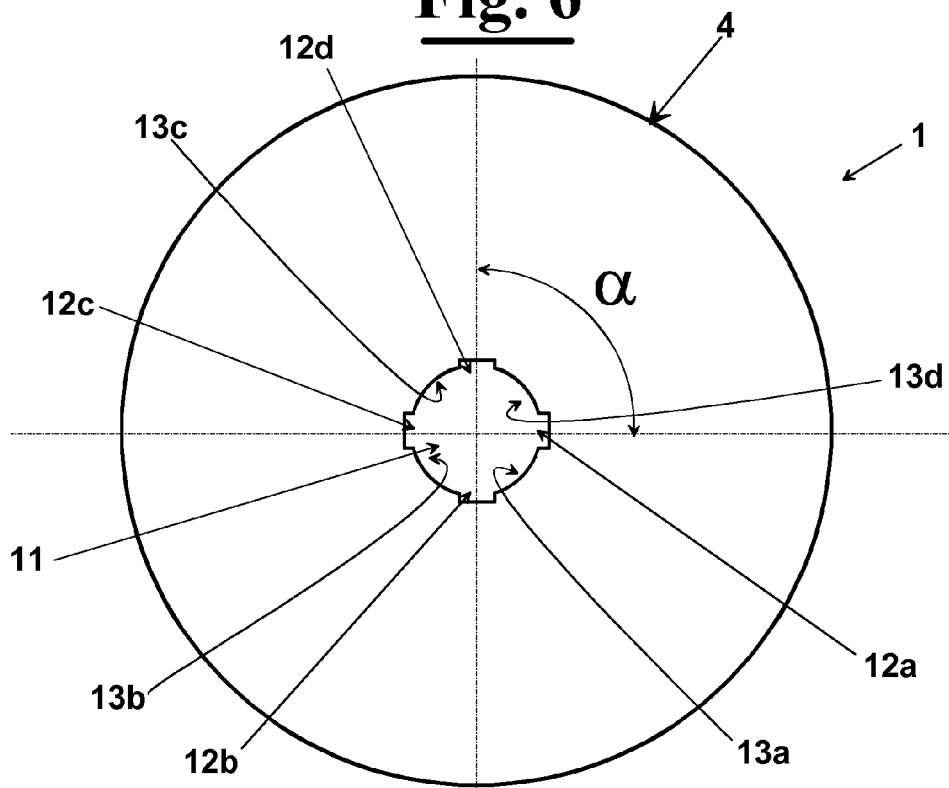
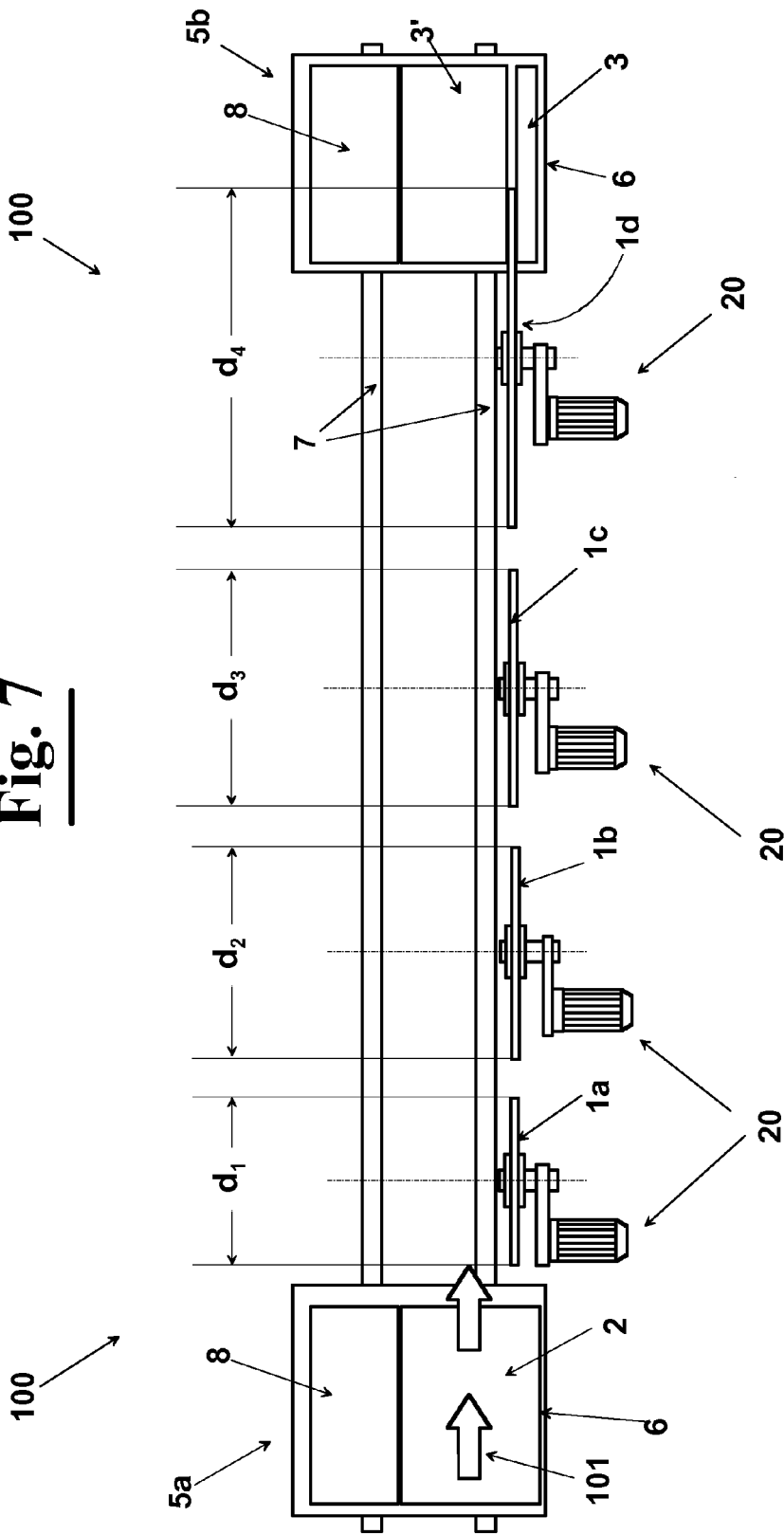


Fig. 7



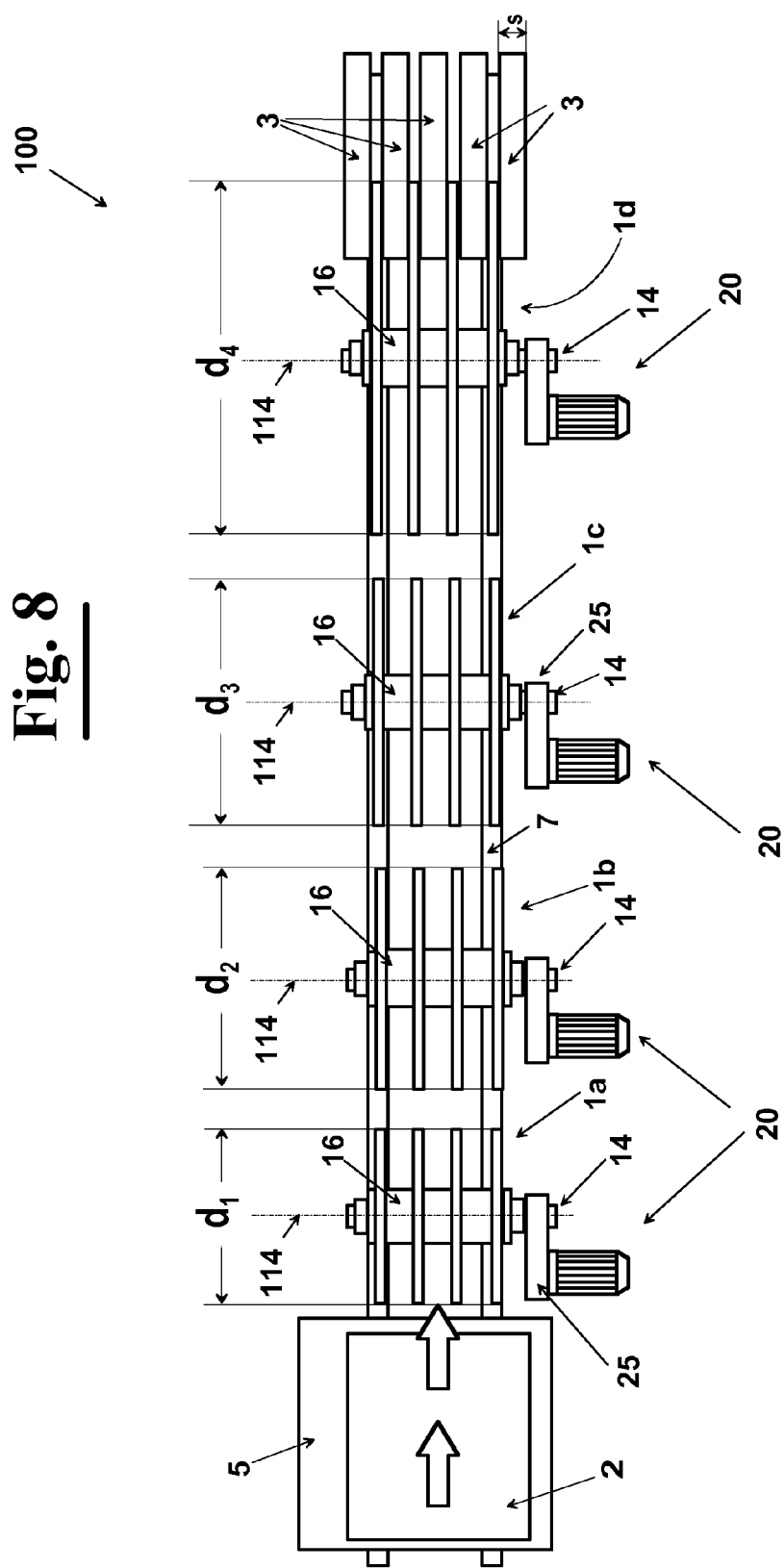


Fig. 9A

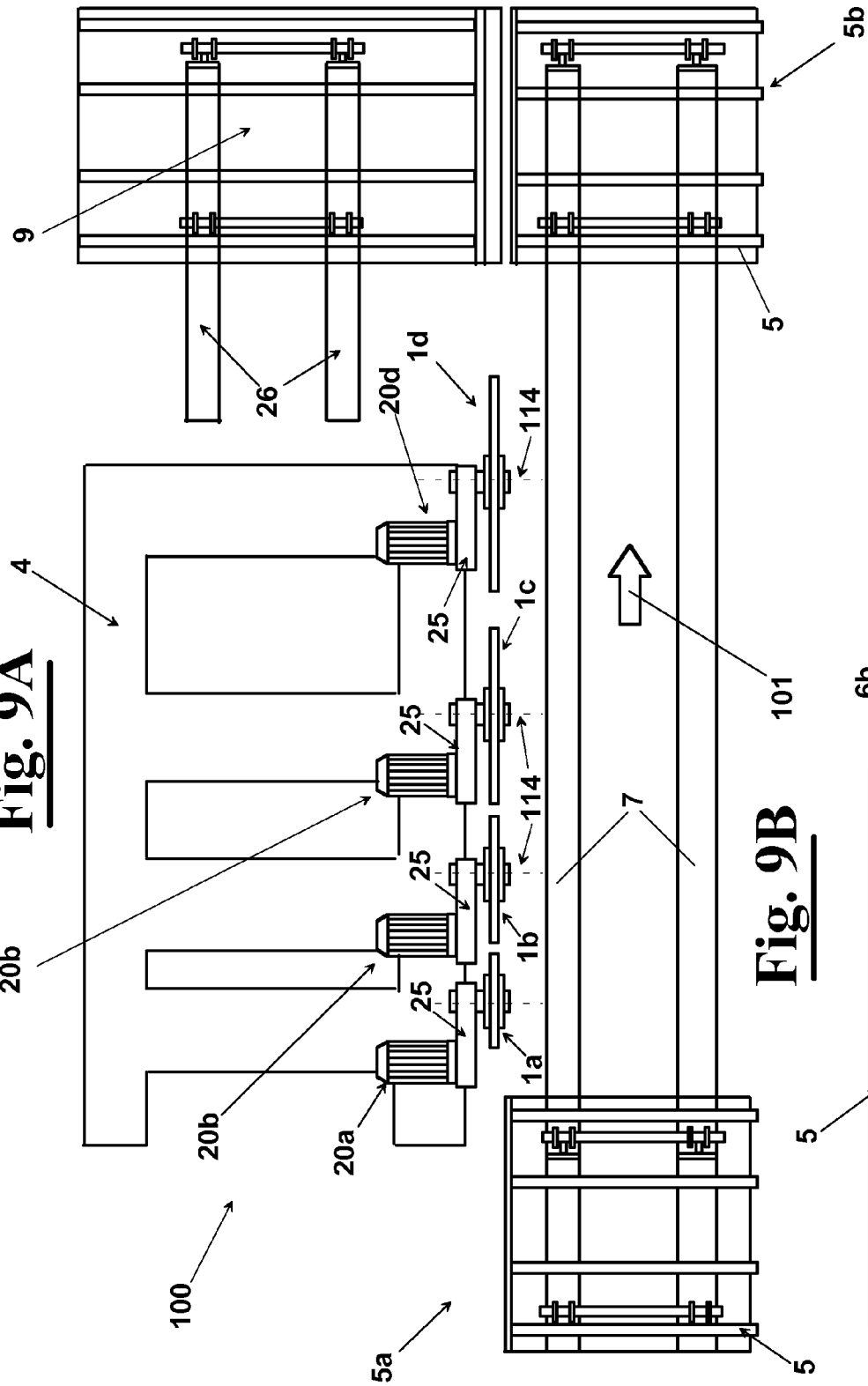
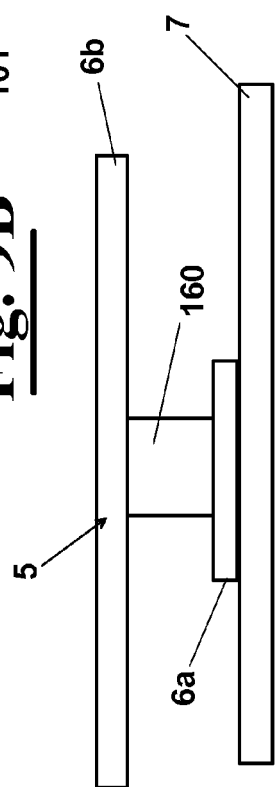


Fig. 9B



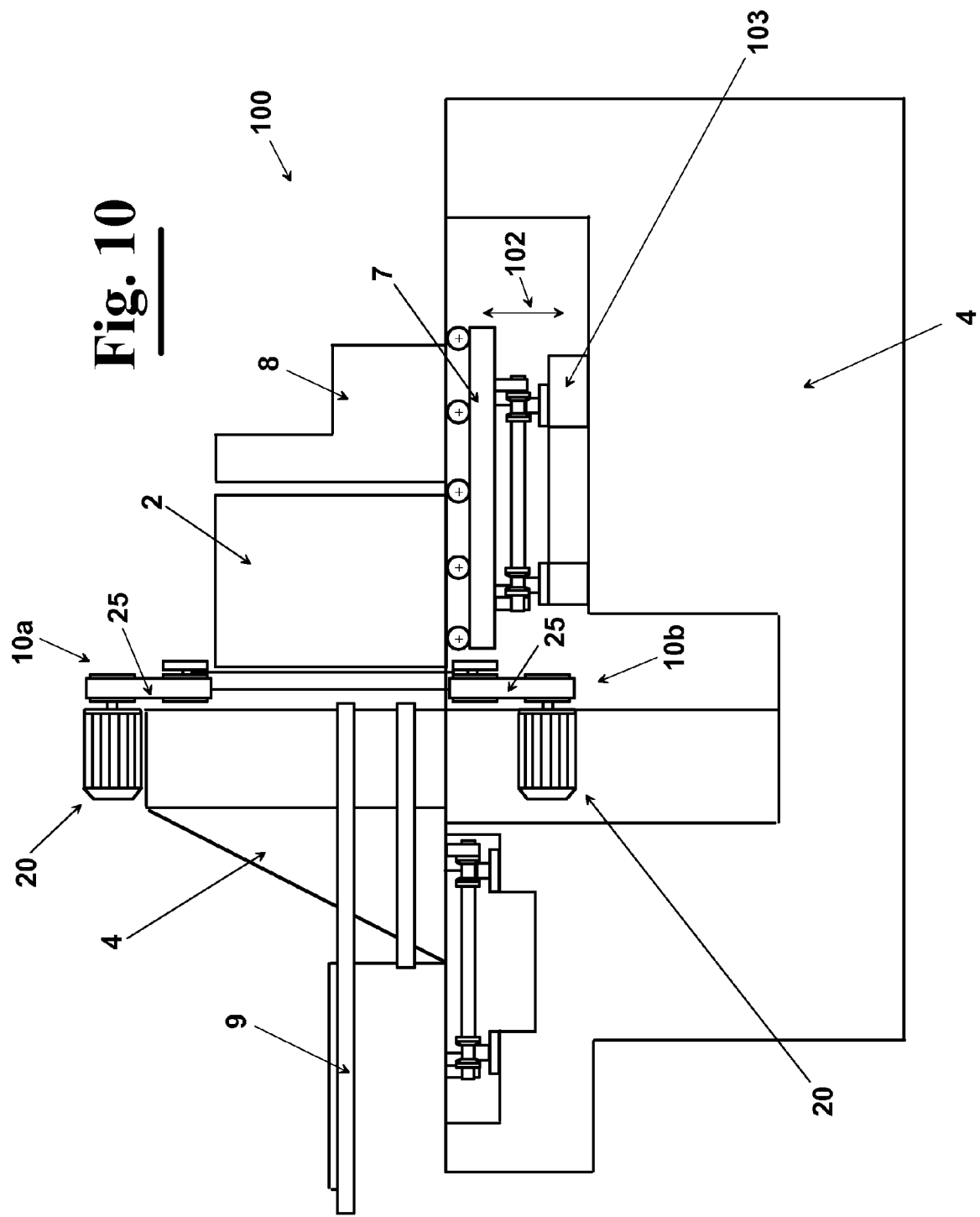


Fig. 11

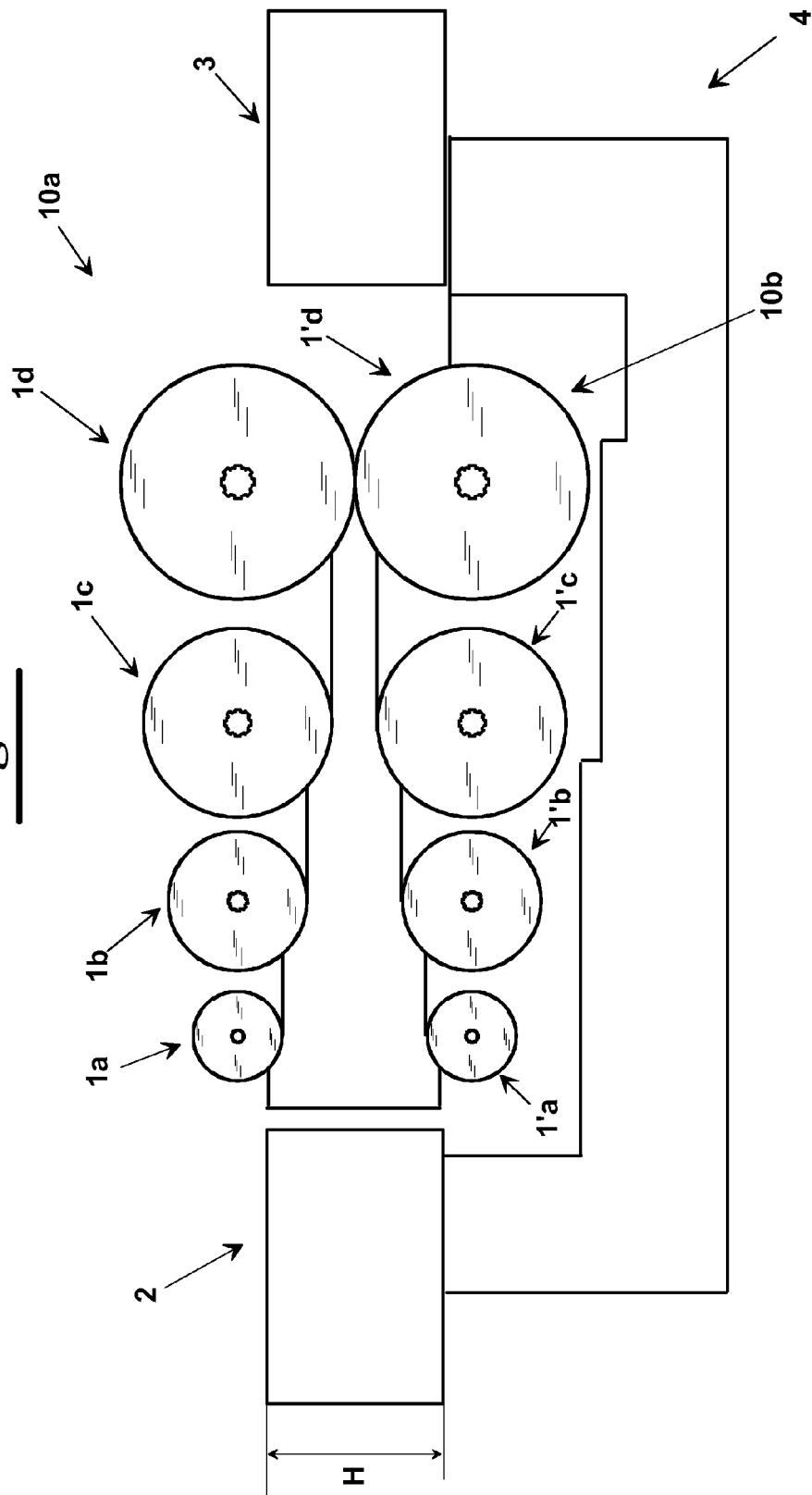


Fig. 12

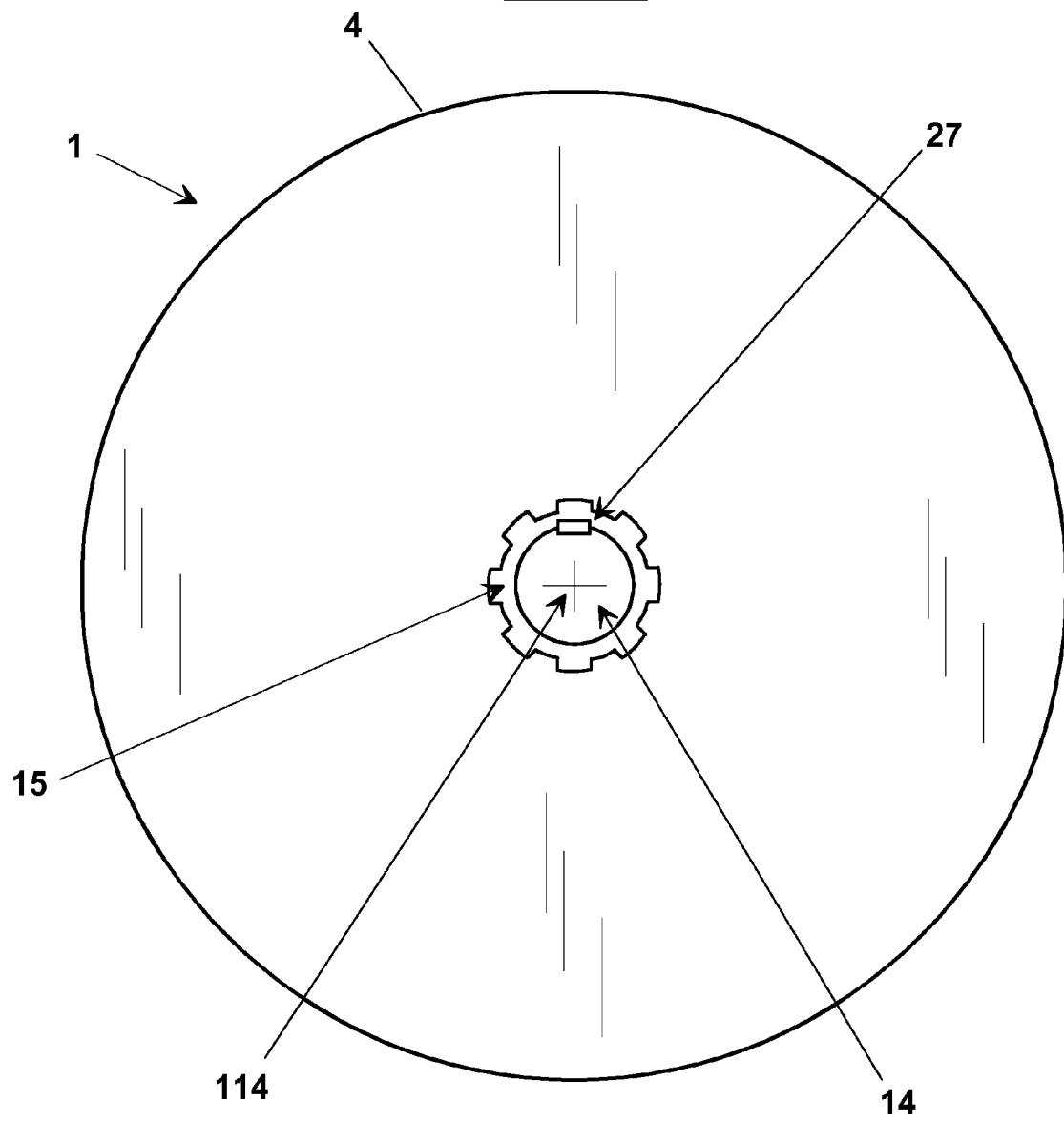


Fig. 13A

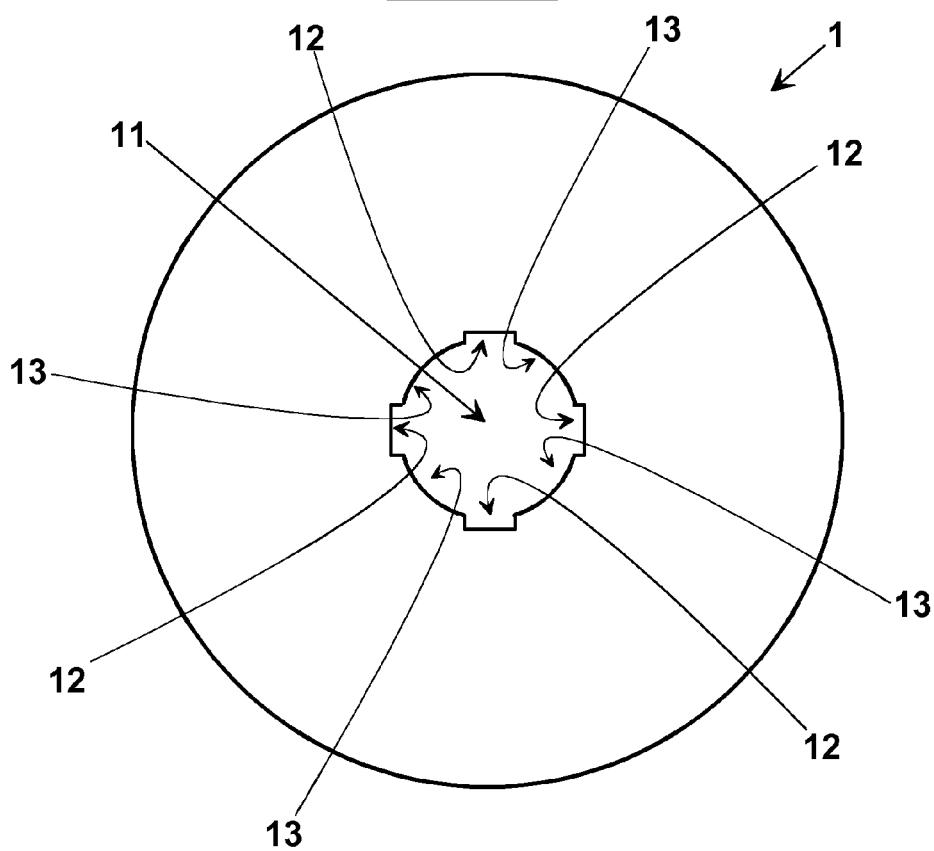


Fig. 13B

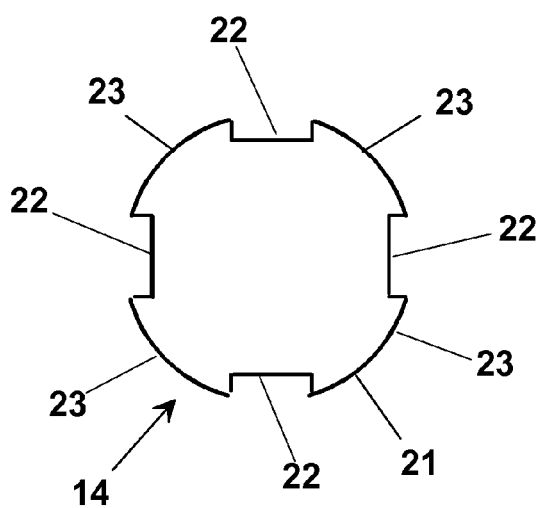


Fig. 13C

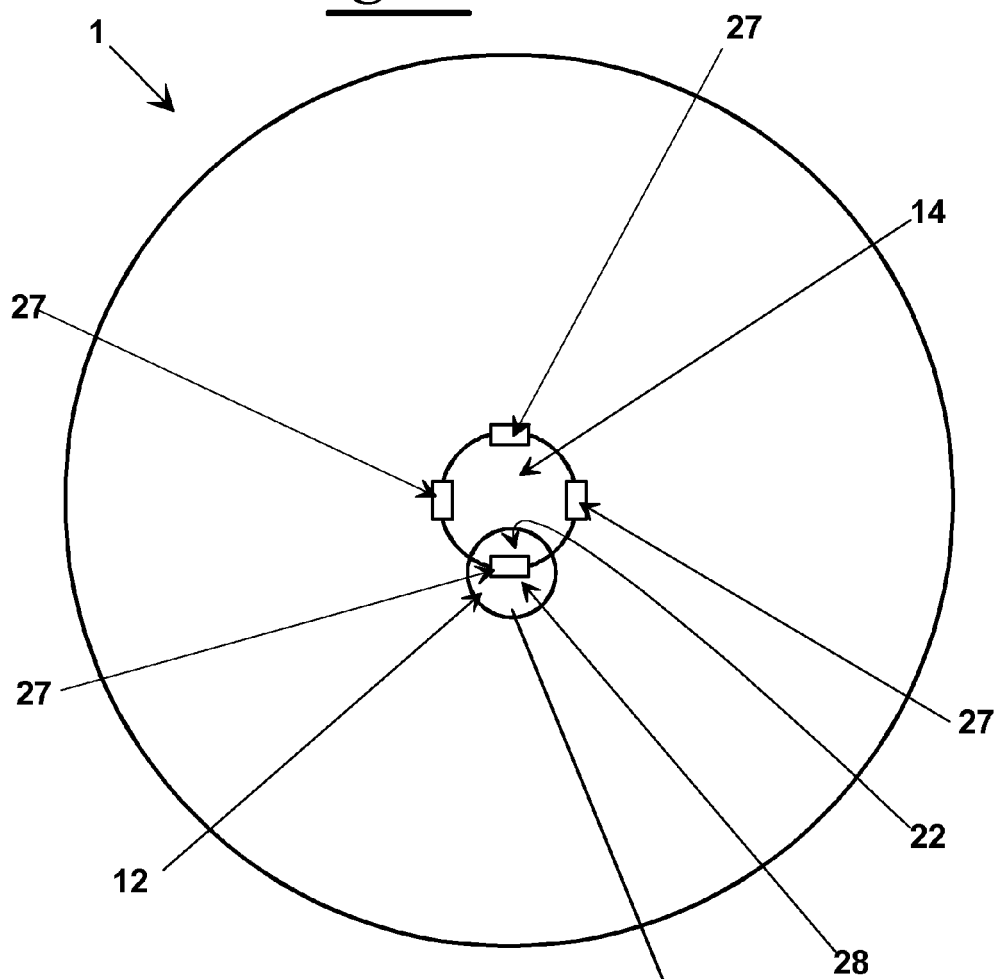
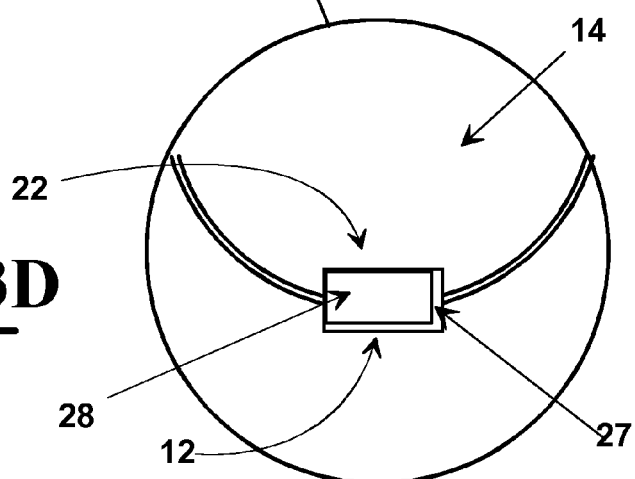
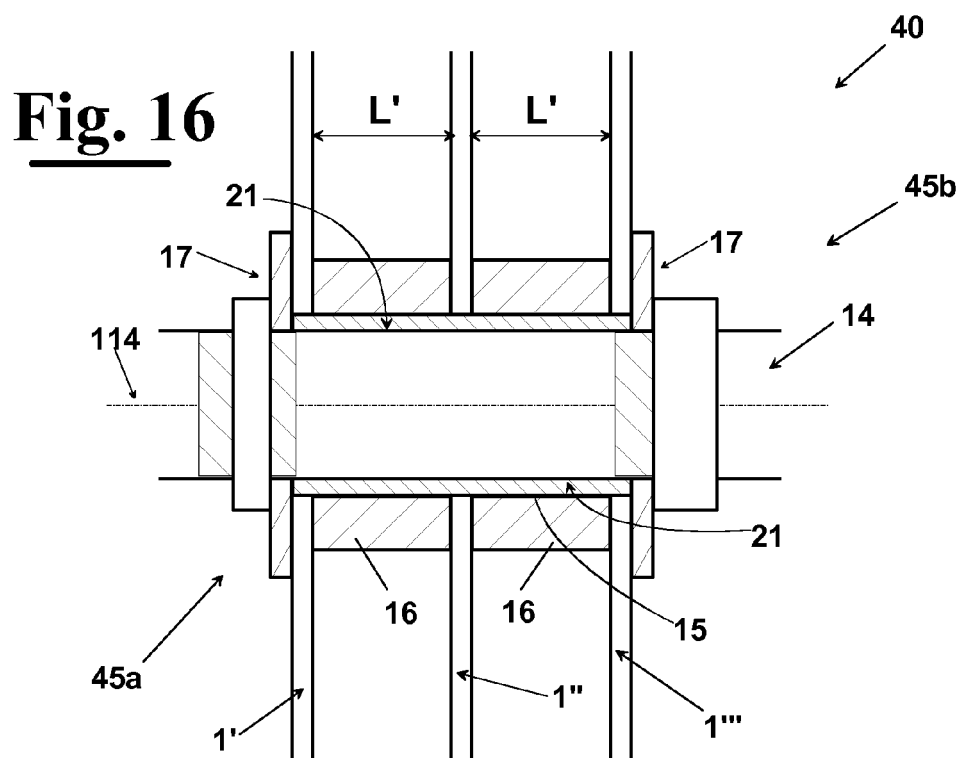
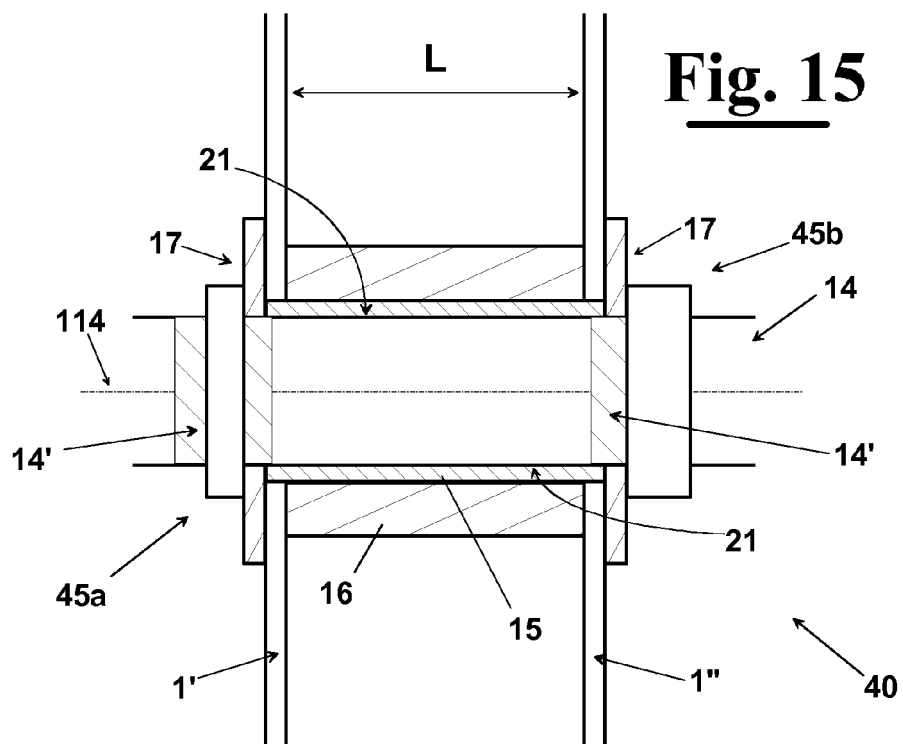


Fig. 13D







EUROPEAN SEARCH REPORT

Application Number
EP 13 15 4300

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Y	EP 0 467 019 A1 (HENSEL EISENWERK [DE]) 22 January 1992 (1992-01-22) * abstract; figures * * page 3, lines 39-48 * -----	1	INV. B28D1/04 B23D61/02 B27B5/30
Y	WO 98/02286 A1 (PRECISION ARBOR SYSTEMS INC [CA]) 22 January 1998 (1998-01-22) * abstract; figures * -----	1	
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A,D	US 4 131 103 A (ISHIZUKA HIROSHI) 26 December 1978 (1978-12-26) * column 2, line 67 - column 3, line 15; figure 3 * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B28D B23D B27B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 June 2013	Examiner Garella, Mario
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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